GRAPHIC SCIENCE

OCTOBER 1960

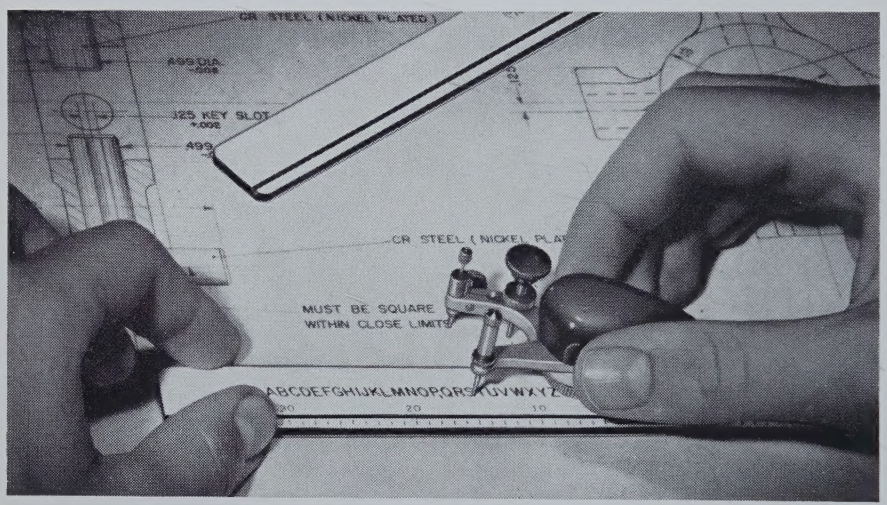
Some Ideas

for your file of practical information on drafting and reproduction... from

KEUFFEL & ESSER CO.

When it comes to lettering – plain or fancy – professionals the world over turn to LEROY® Equipment by K&E. In drafting rooms, art departments – not to mention schools, business offices, churches, clubs, hospitals – LEROY has become almost as necessary as pencil and paper.

Truly, there's no magic about LEROY – just a beautifully simple idea, translated into products which reflect the highest manufacturing skill and imagination. Not easy, we grant you . . . but not magic.



However, to keep the LEROY line constantly up to the changing requirements of the times – that *does* require a wizard. Fortunately, we have just such a gentleman firmly settled on the K&E payroll. And he begs that we report several of the more recent minor miracles of LEROY right here and now. So, in the famed standard, sans-serif lettering template, let's make with a little . . .

abracadabra

Templates

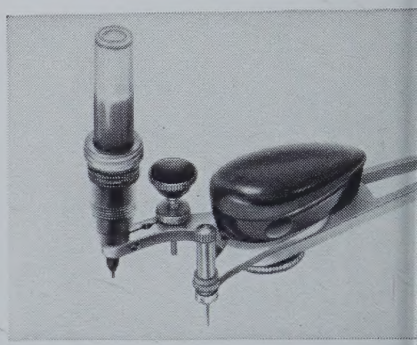
Every year sees new additions made to the already long list of LEROY templates. Case in point: the new electronic tube symbol templates for use in one of the most modern, fastest changing industries of them all. Also, there are foreign language templates (such as Russian and Greek), music templates, special designs, and a variety of handsome type faces (Caslon, Cartographic, Bernhardt Modern to name some newer additions).

The best advice we can give for keeping current on LEROY templates is to have the LEROY catalog on hand. (It just so happens that we recently put out a brand new edition of the catalog, and it's yours for the asking. See coupon at right.) Finally, of course, we should add that if you don't see what you need in our catalog, don't despair. We'll produce it, *custom-made*, to your design – as we have done for thousands of others.

A "Built-in" Pencil Point

The business of stopping work to put a sharp point on a lettering pencil is now largely over and done with, thanks to another new LEROY item. The point of the new LEROY "020" pencil never blunts or dulls – it's permanently sharp. And that, we submit, is a pretty sharp idea. The lead of this new pencil is an unvarying .020 inches in diameter, from one end to the other. All that's necessary to repoint is to advance the lead with a turn of the pencil

shaft. No need to remove it from the scriber, by the way. This new pencil fits all LEROY scribers, and guarantees faster, smoother work. As to appearance – all lines drawn with the "020" are perfectly uniform, and of exactly the same densit (a careful balance, chosen to give goo wear without sacrificing print-makin quality). You never saw pencil work loo so good.



The Pen With A "Built-In" Inkwell

Here's your ticket to faster ink work wit far fewer refills–K&E's new LEROY Re ervoir Pen. You'll be amazed at the mileag you can get between refills with this newl perfected pen. Its refillable cartridge hold enough ink for many hours of smooth, un interrupted lettering, thus eliminating th need for daily cleaning. The pen's cartridg is airtight – made of a non-porous, un breakable, translucent material. The leve of ink is always visible, and any non-so vent, waterproof India drawing ink can b used (for best results and quicker, easie filling we recommend the LEROY Lette ing Ink-Cartridge #2950).

A tiny weighted needle inside the pen feed tube assures a clear passage of in from reservoir to point. Light vertic shaking of the pen activates this needl removing any particles which may hav settled in the tube when the pen was se aside. The needle also provides efficien cleansing action when you wash out th pen.

LEROY Reservoir Pens are furnishe in seven sizes, from 00 to 5, for use with a LEROY scribers. Ideal for lettering worl the points glide easily over paper, cloth o film based surfaces, producing sharp, un form lines that reproduce crisply.

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Other new additions and improvements too numerous to go into here – are de scribed in the new LEROY catalog. TH coupon below brings your copy, free.

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GRAPHIC SCIENCE

THIS ISSUE, 11,600 COPIES

OCTOBER 1960

VOLUME 2 NUMBER 10

The Magazine of engineering drawing management, covering drafting, reproduction and microfilming, technical illustration, drawing standards and drawing filing in all industries.

FIRST ANNIVERSARY ISSUE

ARTICLES

DEPARTMENTS

GRAPHIC SCIENCE is published monthly by Kinelow Publishing Company, Inc., 103 Park Avenue, New York 17, N. Y. (MUrray Hill 5-1745). Charles E. Rhine, president; Paul Yake, vice president; David Z. Orlow, secretary-treasurer. GRAPHIC SCIENCE is published (printed) at 116 Main St., Norwalk, Conn. Address changes, undeliverable copies, and orders for subscriptions should be sent to Editorial Offices, 103 Park Avenue, New York 17, N. Y.

Postmaster: Form 3579 requested.

Subscription rates: $8.00 per year in the United States; $9.00 per year to Canada; $10.00 per year to other countries. Single copies: $1.00.

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Superb, high-contrast emulsions now ON ESTAR BASE

Now you can meet the job at hand with intermediates that are as tough as they come and have exceptionally sharp detail.

Big new plus in these 3 films is Kodak's Estar Base which gives much longer life and greater dimensional stability to reproductions of drawings, maps, documents.

These new Estar Base films are highly translucent for fast "print back". . . have an excellent matte surface on both sides for easier drafting . . . won't turn yellow or become brittle . . . and are resistant to moisture. Available in popular cut-sheet sizes and in rolls up to 52 inches wide.

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1. Kodagraph Autopositive Film, ESTAR BASE
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Changing scale is easy with this high-contrast, quick-processing film. It gives you sharp, clean results when enlarging microfilm negatives, or reducing large drawings, blueprints, maps. Can be handled with "1A" safelight, and exposed in enlargers, projection printers, process cameras.

Really something every engineer, draftsman, and blueprinter should get full details on now. Call your local Kodagraph dealer for free literature, or write to Eastman Kodak Company, Graphic Reproduction Division, Rochester 4, N.Y.

NEW! **Kodagraph**

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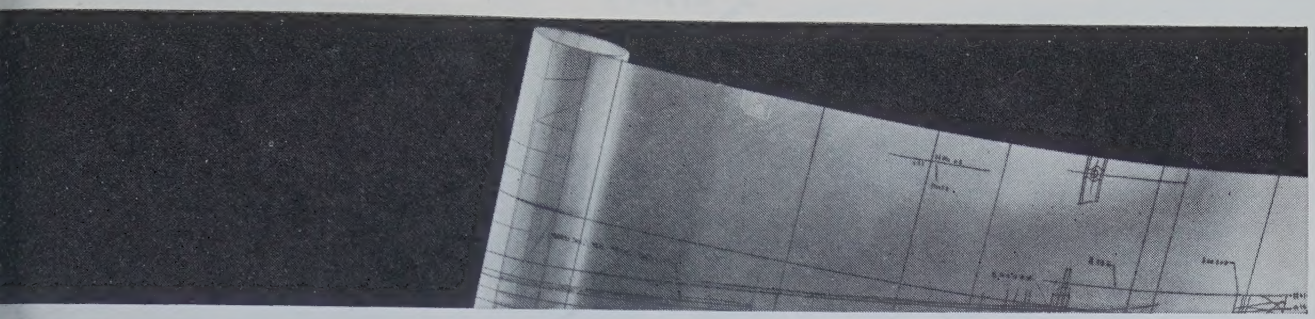
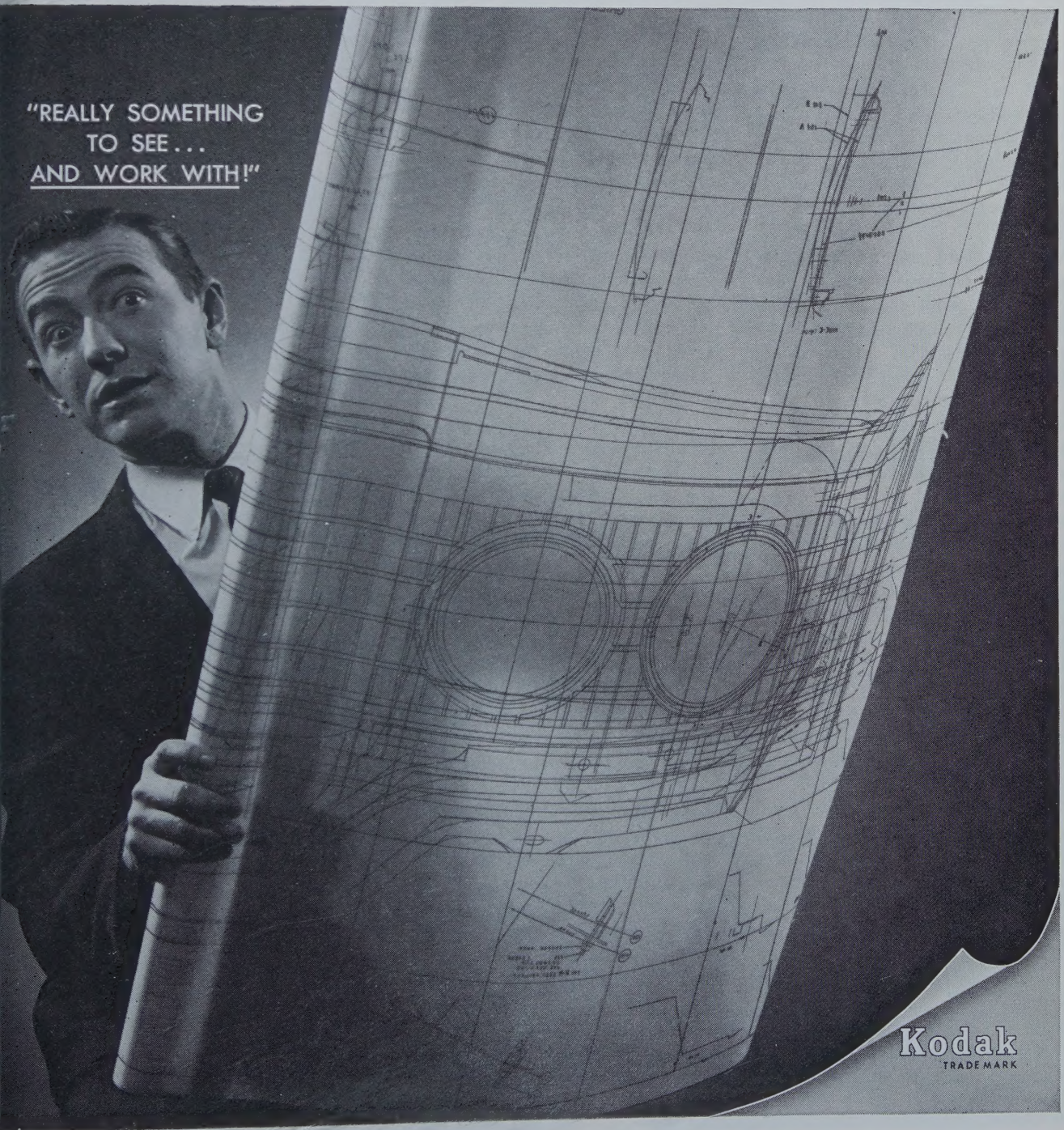


KODAGRAPH FILMS...



Letters

MIL-D-70327

Sirs:

Your papers on the subject of MIL-D-70327 were most interesting and valid. It certainly is a mighty task DOD has taken on in "across-the-board" standardization. Some of us actually working in a military activity, however, see no real need for such complete uniformity (except in certain basic drafting practices), especially when increased costs are evident.

All of our problems are not alike in the drafting, reproduction, and distribution areas. Navy Yards, for example, are a job shop as far as manufacturing is concerned. Many smaller projects are often detailed entirely on one roll-size sheet. Manufacturing is low-volume, and at times the drawing is only for one job. How can mono-detail pay off for us, either from a drawing preparation or filing standpoint?

We have some control over drafting quality on new drawings prepared. How about the 20 years of "junk" we've collected in our drawing files, the poor intermediates, patched-up photo-tracings, etc., that we still need but can't afford to redraw? The best filming and blowback techniques are of no value here.

In 1955 the continuous-flow Neoflow reduction and blowback equipment was chosen as the most applicable to the Shipyard's problems. Very tangible and large savings have resulted through the issuance of half-size prints (from Neoflow intermediates) to production. The blowback equipment does a good job and is optically and mechanically sound, but is of no real use until all Naval Shipyards have the equipment. However, we do not expect the entire DOD to come along with us on this.

Mr. Rowen Glie made some very good points and I'm sure that he will agree that only an idiot would reject drawings on some of the minor grounds he stated. Standardization is good as a general rule, but an absolute standard covering the entire DOD may not be the right course at this time.

I strongly disagree with Mr. Glie's views that functional drafting and freehand sketches are not compatible with microfilming. He did state the correct requirements that a drawing must meet to make acceptable reduced film copy. All of these requirements are attainable using functional drafting techniques. It depends on the draftsman, not the method.

I'm doing a bit more drum beating for functional drafting, and with reference to your article "BuShips Transforms Engineering Drawings File" I have some comments. In 1959 I visited the LVT plant in Kalamazoo, Michigan, and observed the system described in Mr. Moravec's paper. Considering the class of work, the system did seem well suited and efficient. I did note, however, that blowback from 35mm was not used for *production* drawings, but only for engineering reference.

What impressed me unfavorably were the redundancies in the drafting presentation. Mechanical lettering, extra views and largé format meant extra taxpayer's dollars being used with no tangible return. By using just a few functional drafting rules I could see 40 per cent savings in drafting time, and in many cases a lessening of reduction ratio when microfilming —through larger scales or reduced format.

It is possible, of course, that the Military engendered high costs by certain inspection procedures. In looking over the LVT drafting manual and the leeway allowed, it would appear that possibly industry gilded the lily in this instance.

Probably we who work in a military organization deviate more from our own drafting standards than industry. This is because we analyze the nature and extent of our problems and are able to solve them in the most economical manner. This same freedom is not allowed to industry.

Certainly great strides can and should be made by DOD toward standardization in a general way. But until all the defense activities and services problems are more nearly alike, let's not carry standardization to the point where it costs more than it can possibly save.

In closing I must add that the opinions expressed here are only mine, and not necessarily those of the Navy Department.

R. E. Meyers
Head, Value Engineering Branch
San Francisco Naval Shipyard

Microfilming

Sirs:

We read with interest your recent articles on microfilming and would like to avail ourselves of your offer of additional articles which would be helpful to us in formulating our program. We are currently considering installing microfilm aperture card and electrostatic printing systems in our three Oak Ridge plants. Our experience with microfilming is quite limited, and anything you might be able to provide in the way of information will be appreciated.

We would appreciate it very much if this information could be supplied in six copies, in that it will require review and consideration in all three of our plants.

W. M. Stanley, Jr.
Superintendent
Planning and Standards Dept.
Oak Ridge National Laboratory
Oak Ridge, Tennessee

Wanted: Bits and Pieces

Sirs:

I have received and keep with pride each copy of Graphic Science and am very happy that the Drafting Profession has been recognized, of which I for one am proud to be part.

I am preparing an educational program for our internal use, to create a more profound understanding among Drafting, Engineering, and Production. Too many times a drawing is made which causes Production hardships and vice versa.

Among your many readers this information is available. As insignificant as it may seem, small bits of information can be correlated into an impressive program which, when completed, will be available to the profession.

It will be appreciated if you can find space in one of your future issues for this request.

Keep up the good work.

Yours very truly,
James Lindsay, Jr.
Drafting Supervisor
Bird Electronic Corp.
30303 Aurora Road
Cleveland 39, Ohio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PELIKAN GRAPHOS drawing ink fountain pen; for finer, smoother drafting, illustrating, lettering; cuts stop-and-fill time 90 per cent; 60 interchangeable nibs.
PELIKAN FOUNT INDIA excellent drawing ink for any fountain pen; dense black, non-clogging, quick drying, free-flowing.
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Notes & Comment

"The Passing of the Pro

". . . I was talking the other day to a group of architects who were deploring the passing of pro standards in the drafting room. That sturdy character who kept drafting room production in line—the Chief Draftsman—and the fully competent Draftsman himself, are inclined to be ambitious today to move on quickly to the front office. Again, this is surely not to be lamented; the more rapid progression from school through the drafting room to principalship or one's own office is a happy situation for architecture, and is one reason that a freshening of the profession as a whole has taken place in the postwar period. But the drafting-room phase, as a consequence, has become more of a transition and not a culturing ground for the pro draftsman, interested solely in good drafting, good detailing, good lettering, and competent *pro*-duction. As a result, my friends felt, the skills needed for this part of architectural creation have been largely lost, and are not being replaced. It may all be a sentimental attitude—an exaggerated recollection of abilities that may not be so lost as they think, nor have been so great as they remember. In one field the amatuer does equal the pro—that of reminiscent story telling."

THOMAS H. CREIGHTON, Editor
Progressive Architecture
August 1960 issue

Overseas Agreement

A MAJOR overseas agreement in the photographic chemical field with Johnsons of Hendon, Ltd., in England, was recently announced by Cormac Chemical Corporation of New York. Manufacturers of UNI-BATH, one-step processing solutions for photographic films and papers, Cormac revealed the completion of negotiations for manufacture and distribution throughout the European Free Trade Association, comprising the United Kingdom, Switzerland, Sweden, Norway, Denmark, Portugal and Austria.

GRAPHIC SCIENCE

OCTOBER, 1960

VOLUME 2 NUMBER 10

Automated Electrical Drafting Through Photography

Photocomposition saves up to 75 per cent of drafting time, and improves diagram legibility

by D. F. Thompson

The General Electric Company has long recognized the use of photography as an aid to the draftsman and to the engineer. A section within the Engineering Department has been set aside to develop these processes. The process described herein was developed by the efforts of many, and was accomplished during "Operation Upturn," a company-wide program undertaken to improve product quality, provide extra value to the customer, and to establish cost leadership. Many of the processes used by the Industry Control Department are also being used by other departments of the General Electric Company, as well as by their competitors. The Industry Control Department in Salem, Virginia, completely wires, punches holes, and assembles control components using documents made by photographic processes.

THE FIRST ELECTRICAL diagram to which photocomposition was applied at the General Electric Company Industry Control Plant in Salem, Va., was the elementary diagram. This diagram is often referred to as the schematic drawing. It details all the circuitry of an electrical control system, and is used to tell the complete story of a controller in the shorthand of engineering language (symbols).

Previous techniques of making elementary diagrams varied widely, and the advantages of similarity and uniformity were lost. Many attempts were made to maintain some similarity between diagrams by using templets, lettering devices, and drafting machines. No practical single method of mechanization had been found, however, which adequately overcame existing problems without creating new ones.

The physical size of the hand-drawn elementary diagram presented a problem in itself. In order to be legible, it had to be drawn to a large size, in many cases 24 by 36 inches. When instruction books were required, photo-reducing was necessary to make the diagrams the same size as the 8½ by 11-inch pages. In order to preserve legibility when this much reduction was involved, mechanically scribed masters were used. These required many man-hours of tedious drawing.

FIGURE 1. Previous techniques of making elementary diagrams varied widely and uniformity was lost.

We at General Electric decided to photocompose our diagrams at an 8½ by 11-inch size. In the majority of cases, we have reduced our diagrams to 25 per cent of their original size. This size diagram is well suited to binding into instruction books. The diagrams are not only handier to use, they are sharper and more readable as well. They are less costly, and they have proven highly acceptable to our customers.

A reduction in floor file space can be realized because of the small size of the diagrams. Only small reproduction machines are required, and they can be set once and run at the highest rate of speed, since the diagrams are sharp and uniform.

PHOTOCOMPOSITION

THE PHOTOCOMPOSED diagram is machine-made by an operator in much the same manner as typewritten material is produced by a secretary. The "keyboard" in this case includes the electrical symbols used on the elementary diagrams (see Figure 3). The characters, instead of being typed on paper, are reflected as an image on film. In short, the machine takes a picture of each symbol photographically. The picture can be made any size by calibrated operator adjustments provided for this purpose.

(What's wrong with this picture?)

Are your bookkeepers better equipped than your engineer-draftsmen?

Yes, today's bookkeeping procedures demand accuracy and productivity—equipment that guards against error, while saving time. Your professional engineer-draftsmen, too, need modern equipment for top efficiency, as their work helps establish your productivity throughout the *entire* product-planning and manufacturing cycle.

Your draftsmen, your productivity, deserve new Hamilton space-and-time-saving equipment—from Keuffel & Esser Co.

You *keep* your best men productive by giving them the equipment they need to do their best work, and you eliminate costly errors fostered by inadequate or antiquated equipment. In Hamilton equipment, *you get top productivity for every square foot of floor space.*

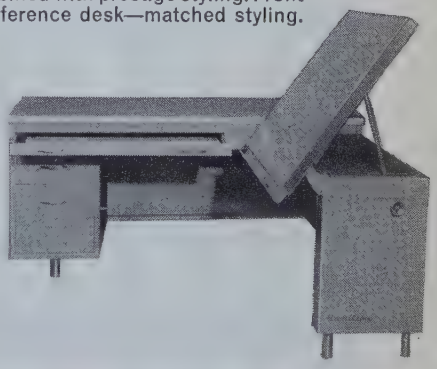
Not only do all Hamilton units start to pay you the minute they go on the job, but they *keep* working harder for you *every* minute—because they're so ruggedly constructed, designed for greater ease and comfort—consequently lower fatigue.

The Hamilton units are themselves a product of meticulous engineering and long experience—features and dimensions established as *ideal*, in many thousands of industrial installations. Yet they deliver the flexibility that every individual and every department require. Our experienced planning engineers are at your service to help select the best arrangements for your needs.

Hamilton De Luxe Auto-Shift Tables
Scientifically seasoned drawing surface; concealed mechanism controlling height and slope flexibility, can be moved with fingertip pressure; linoleum-covered reference surface. Many functional features, combined with prestige styling. Front table, basic table, and rear reference desk—matched styling.

Hamilton CL 100 Series
Entirely new, canted-leg styling assures stability without side crossrails. Strata-Core board, with green linoleum surface, both sides steel edged; tilts 0° to 40°. Fully adjustable recessed footrest; steel reference, tool, and catalog drawers. Other fine features, superb styling in light Sahara-Tan, satin-chrome hardware.

Hamilton L-Contour Unit
Counterbalanced, range of board adjustments permits frequent position changes—at finger touch—offering greater flexibility of work arrangement, lessening fatigue. Telescoping legs adjust height 30″ to 31″. Generous storage facilities, durable linoleum reference surface. Beautiful utilitarian styling, maximum space efficiency, constructed for long service.



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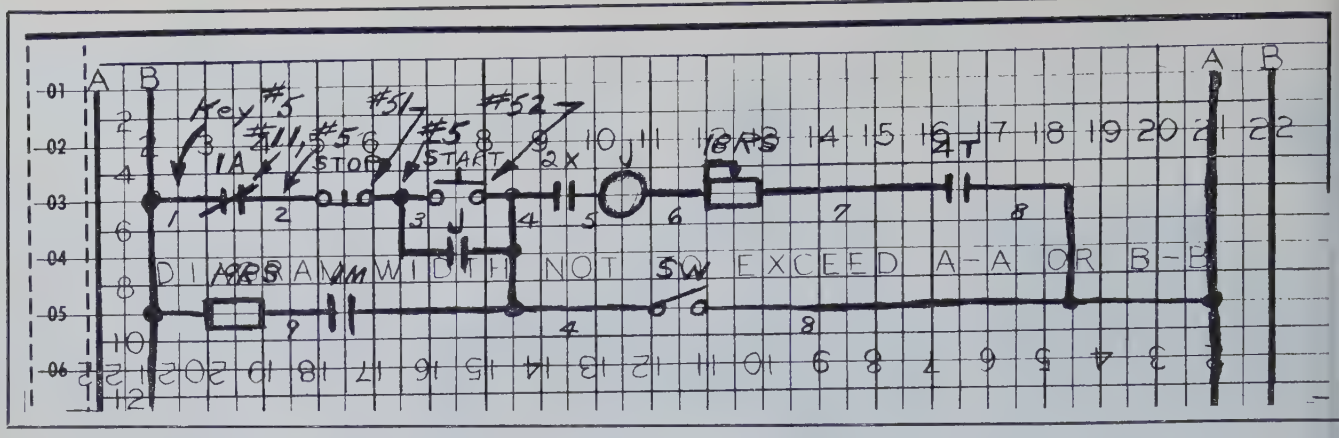

FIGURE 2. Engineering free-hand sketch of typical circuit.

Since the photocomposition machine operator is not a highly trained engineer or draftsman, he must be told what to draw (or type). The instrument that tells him is the engineer's free-hand sketch. This sketch shows the control system as the engineer conceives it in the design stage of the job. The only restriction placed on the engineer is that he must use specially lined paper for his sketch. And of course he must employ only those symbols available on the machine which are the accepted industry-wide standards. I might add that the use of standard symbols is the only area in which the photocomposition process stifles the creativity of our designers. The sacrifice is justified, however, by the everlasting gratitude of our customers throughout the country.

Numerical and alphabetical information is set on a film separate from the electrical circuit information. A position indicator enables the operator to place this information accurately, so that it can be overlayed with the circuits.

The final diagram is produced by combining the electrical circuit positive and the alphabetical-numerical positive. These two positives are overlaid with a film containing the title block, and are contacted photographically to make the final diagram. Thus the photocomposed diagram eliminates the drudgery connected with the hand-drawn diagram.

Corrections and engineering changes are made by removing the unwanted portion from the diagram with a specially designed instrument, resetting the corrections on the machine, and inserting these in the film in the proper location. The speed at which an operator can set a diagram has enabled us to make the elementary diagram in the final stages of design, eliminating rework due to changes in design or a revision in the customer's requirements.

By modularizing and standardizing, various innovations can now be realized that were not practical with conventional drafting methods. Standard snap-sheets of film are available to the engineer for placing on the free-hand sketch, eliminating even this phase of the drawing.

In the specification or initial stages of a job, when a customer is deciding on the features that he desires in his control, we can—by using these snap-sets—show him in detail what his controller will be, and also arrive at a more accurate cost estimate for the overall project. It has been our decided value to show our customers

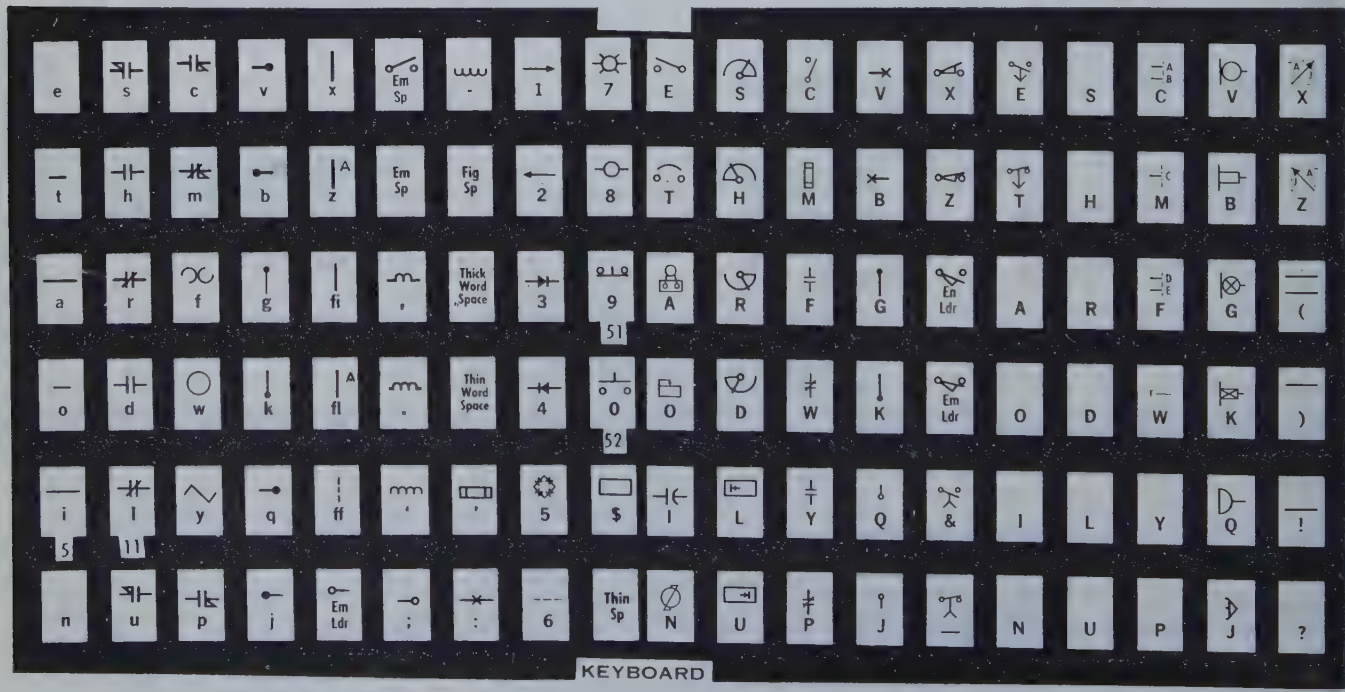

FIGURE 3. Keyboard arrangement of photocomposing machine used for electrical drafting.

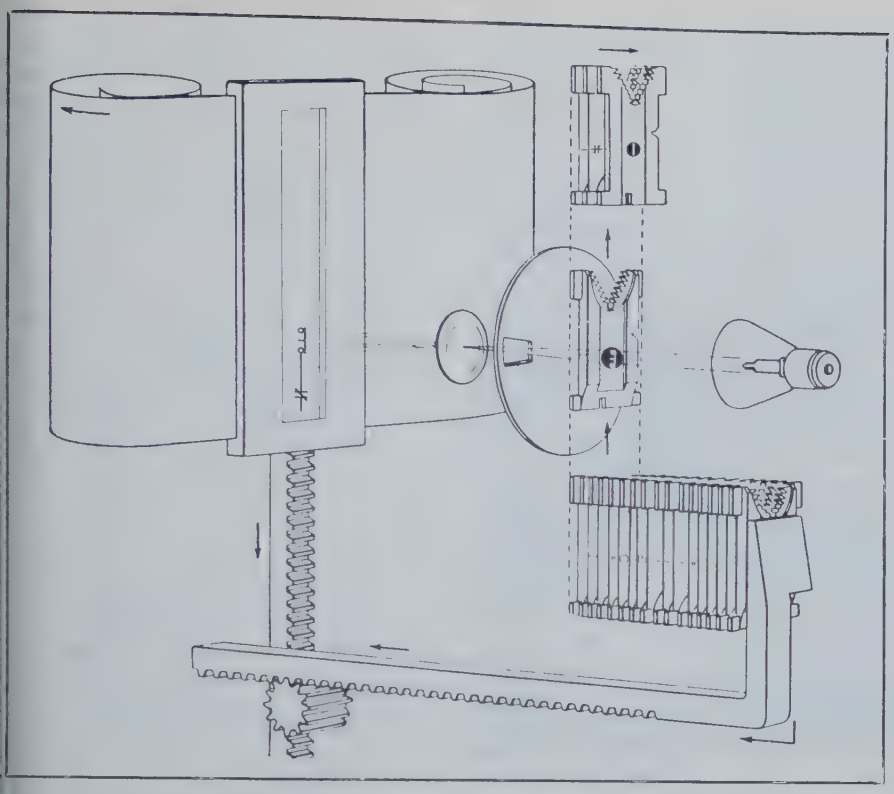

FIGURE 4. Schematic drawing of photocomposition machine. When operator completes a line, he presses lever that sends the matrices, each with its embedded negative, between a light source and a lens to be automatically exposed on the film. Matrices are returned for reuse, each to its appropriate slot.

pictorially what they will receive. Designs are more firm, and the chance for a change after the control has been designed has been reduced considerably.

It is possible, through photocomposition, to show physical pictures of the components in their respective positions, instead of symbols. We do this by the use of photocomposed snap-sets. The customer, in many cases, can juggle the components around much like a puzzle, and establish what is the best design for his particular requirement.

The photocomposing process is now being applied to all types of diagrams. Photocomposition, as a replacement for conventional drafting practices, has proven to be economical. By using the photocomposing machine, we are producing diagrams at less cost, that are easy to read, easy to handle and highly acceptable to our customers.

The System

Electrical symbols used in the industry today vary in size and shape. For simplicity and uniformity in the photocomposition process, it was necessary to establish a uniform size. This size was maintained within a one-half-inch square, and each symbol was adapted to this unit. The composing machine can reduce the symbol to varying sizes. We have established a 50-per-cent reduction as our standard. The connecting lines and points were put on a one-half-unit basis in order to properly connect all the electrical circuits.

The form on which the free-hand sketch is made was adopted to this unit system. This form has one-quarter inch spaces accented every one-half inch. Lines on the form are printed in non-actinic blue so that there is no printback when copies are made. The sketch is drawn on the light blue line, with the electrical symbols falling between the accented blue lines. This rule and guide is not a requirement of the machine; it is merely an aid for those making the sketch. The horizontal and vertical lines are numbered as an aid to the machine operator in setting the location of the symbols in the proper order.

The type of machine we selected utilized the circulating matrix method much like that used in the hot metal machines used in typesetting. It was "a natural" for our unitized arrangement. The matrix is a brass module with a negative embedded in its surface; by passing this negative between a light source and a lens, an image is exposed on the film. When the proper exposure is reached, the machine automatically passes the matrix on, exposing the symbols as dictated by the operator at a rate of 480 characters a minute.

Operation of the Photocomposing Unit

The operator first fastens the free-hand sketch to the front of the machine by pin-up magnets. He then adjusts the line length to the circuits that are to be set. The position indicator has numbers on it that correspond to the coordinated numbers that appear on the sketch.

A typical circuit appears in Figure 2, the light lines and numbers appearing in the background are light blue. The sketch shows a line circuit symbol between the vertical lines, Nos. 2 and 3. The operator depresses the key that corresponds to this symbol, which is No. 5 on the keyboard (see Figure 3). The matrix falls into position for photographing. The next key pressed is for the electrical symbol that appears between vertical lines Nos. 3 and 4. This matrix falls in line next to the line symbol matrix. This process is continued until the entire circuit line is set.

The operator then may review the matrices to see if he has set the information exactly as indicated on the sketch. On the side facing the operator, the symbols and characters are stamped, as may be seen on Figure 4. If a symbol is out of place, the operator removes it and places it where it belongs in the circuit line. This is also done when a special symbol (one that is not regularly used) is required. A rack to the right of the operator houses these special symbols and characters.

When the operator has completed the line, he presses a lever that sends the matrices with their embedded negatives, between a light source and a lens to be automatically exposed on the film. The matrices are then returned for reuse to their appropriate slots (even the specials).

Vertical lines as well as the horizontals are set in the same manner. Between the verticals, blank mats are used to fill in the space.

When the entire circuit has been

FIGURE 5. Correcting device. Corrections and changes are made by removing the unwanted portion, resetting the corrections, and inserting them in the proper location.

set on the machine, the operator removes the exposed film from the machine and develops it in the conventional manner. The circuit is dried and returned to the machine to have the overlay (identifying) data set. The operator inserts the circuit into the position indicator and aligns the circuit with the cross-hairs attached to the position indicator. This position indicator is designed to move at the same increment as the circuit was set. This enables the operator to position the identifying data in the exact location that appears on the sketch.

When the overlay is completely set, it is developed in the same manner as the circuit film. The operator also sets the sheet numbers and the operating instructions on this piece of film, so that it will be handy when the time comes to put the sheet together.

Overlay Operation

The diagram begins with a standard G.E. format that was specially designed for the photocomposed elementary diagram. It provides that circuit widths should not exceed five inches, and that the operating notes and testing instructions should fit between the title block and revision block. The circuit film positive is attached to the standard format first; each circuit line is placed in relation to the cross-referencing numbers. These numbers are an aid to both the testing department and to the customer in locating supporting items to a given device or symbol.

The identifying-data film-positive is then overlaid on the circuit; each title is aligned with its appropriate symbol. The notes and sheet numbers have been passed through a waxing machine to give them a slight adhesive to hold them in place until the sheet is made into a final original.

When the sheet is completed, it is given a comprehensive check. All errors are corrected in a machine specially designed for the composing unit. As each circuit line or title line is set, a hole is punched at either end of the line. These holes are used to advance the film in the machine, and for removing any unwanted items on the film in the correction machine. The corrected data is then inserted in the area removed.

When all corrections have been made, the composite is contacted onto a single sheet in the normal photocopy processing procedure. The finished product is then sent to our print reproduction section for duplication.

The Author

D. F. Thompson is a specialist in the graphic arts field. For the past eight of the eleven years he has spent with the General Electric Company he has been investigating the use of photography as an aid to the draftsman. He is the author of numerous technical articles.

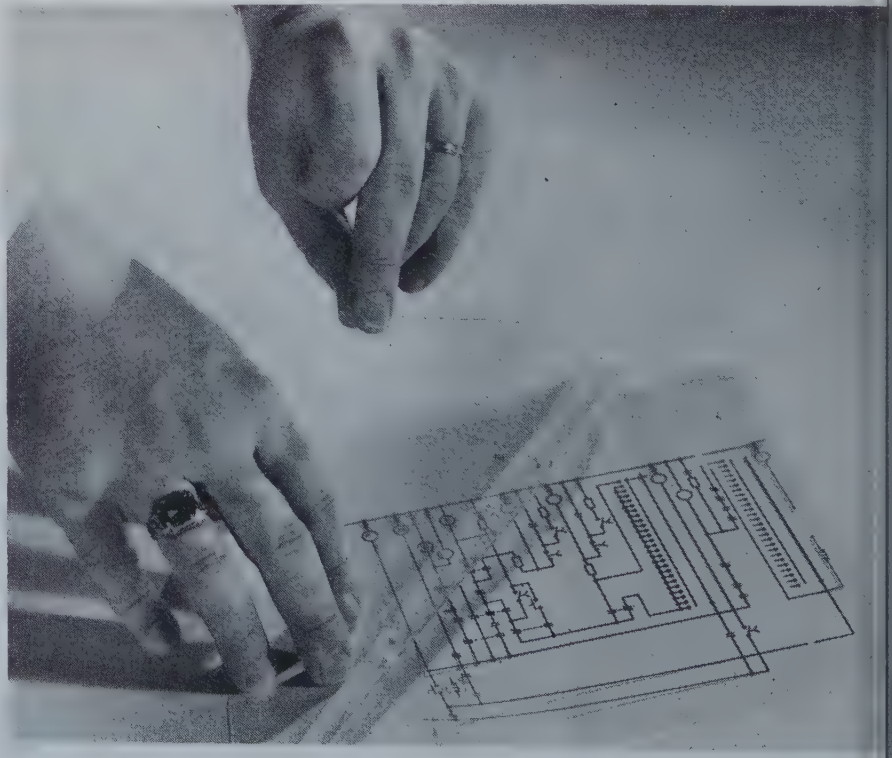

FIGURE 6. The overlay. The final diagram is produced by combining the electric circuits and the identifying information positives.

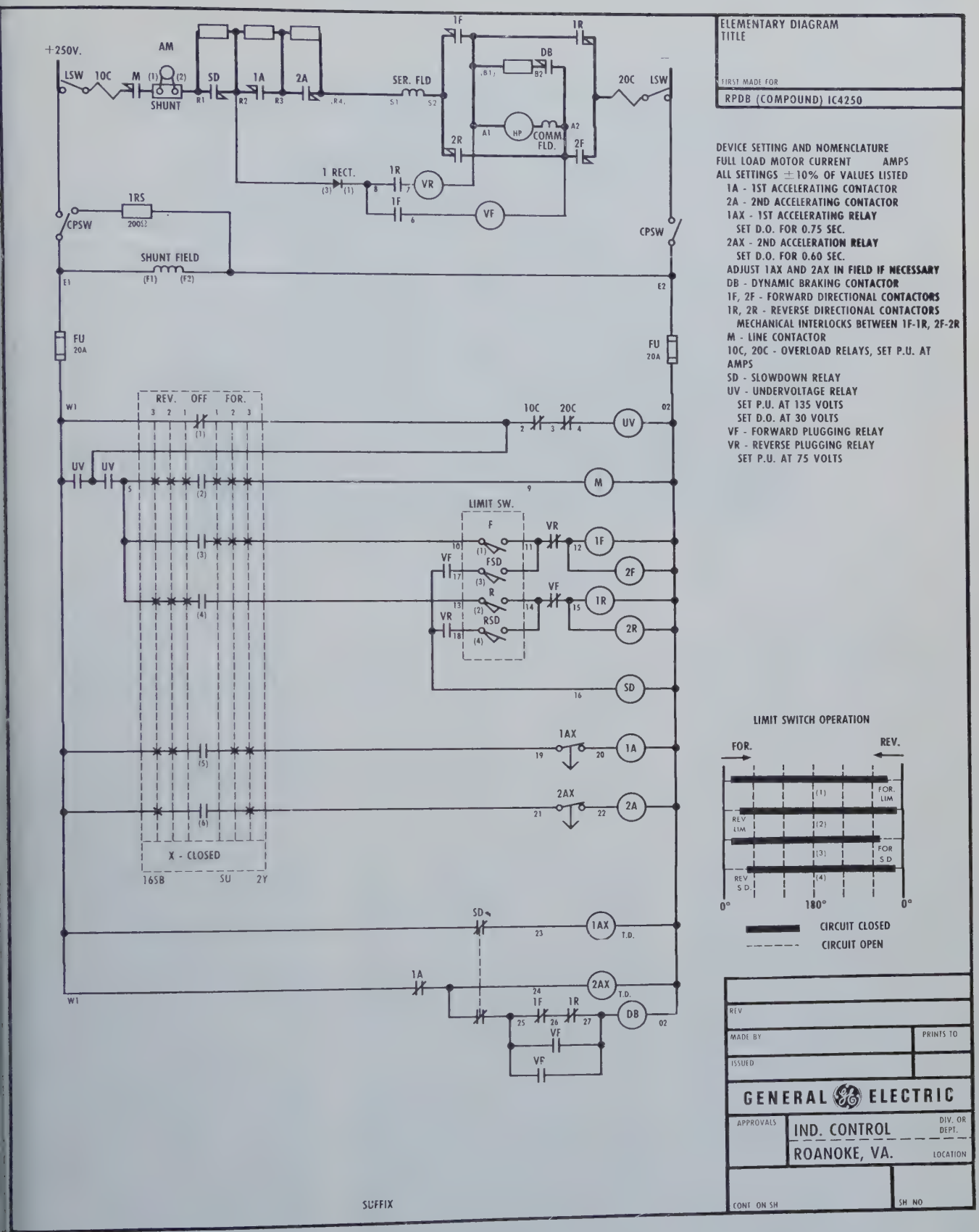

FIGURE 7. Typical photocomposed diagram, produced at the General Electric Company's Industrial Control Department.

SANDBOARD of Archimedes; Roman mosaic from Herculaneum.
(In Rhinish private possession.)

The History of Technical Drawing

I. Prehistoric Times, Antiquity, and the Middle Ages

by Franz Maria Feldhaus

It is with great pleasure that we present the first portion of Geschichte Des Technischen Zeichnens (The History of Technical Drawing), *by Franz Maria Feldhaus. This authoritative and beautiful book was published in 1959 by Franz Kuhlmann, K.G., of Wilhelmshaven, Germany, manufacturers of precision drafting equipment. Illustrations are from the original plates used in the book. We are indebted to Franz Kuhlmann, K.G., for the translation, as well as for permission to re-publish this fascinating work.—The Editors.*

From the time man began to think, invent and actively create, he has endeavored to express his thoughts pictorially, both for his own assistance and to make himself understood by others. Drawing as a means of interpretation is much older than the writing of symbols, for the latter developed out of writing in pictures to the forms used today.

In our search for the origins of technical drawings, we must go back to primitive times, and ask how man drew 10,000 or more years ago. Why did he do it, and how?

We do not possess technical drawings dating from primitive times, but perhaps we can answer the question when we stop to think of how it is done today. When someone explains something, for example, the position of a house or road, or the function of an object, he illustrates his words by making a drawing of the most essential aspects. This happens in a variety of ways; he may merely draw invisible lines on the palm of his hand with the index finger, or he may make lines in the sand with the help of a stick. Even children make their *plans* with a fragment of glass, or a piece of chalk, for hopscotch!

These are technical drawings in their most primitive form, as they have certainly been made in prehistoric times. Practicality always demands a pictorial illustration when large construction is planned or executed. Because we know today that machines for sawing and drilling rock were in use 4,000 years before Christ and that the building of machines up to Roman times was considered a part of architecture, we can even speak of machine drawings in these eras, since the inventors of such machines were certainly supported by drawings of either individual parts or of the whole.

We know that the art of drawing among men goes back some 50,00

years from the wonderful pictures found on the walls and ceilings of Stone Age caves. These are believed to have been drawn or painted some 10,000 to 50,000 years ago. When the first of these paintings was discovered in a cave at Altamira in Northern Spain in 1875, authorities in the field of prehistoric exploration declared that they were not genuine. As recently as 1902, French experts warned against looking at these "fakes." The anthropologist Herbert Kühn made these amazing drawings public in 1921 in his first work dealing with the art of the Ice Ages.

Today we know of more than 30 caves with such wall drawings. While these portray mostly animals of up to 5.5 meters in height, some also depict human beings, head decorations, jewelry, weapons, traps for animals, and huts. The colors consist of ochre, brown iron, black manganese, or chalk, rubbed on with fat or blood. Engraved drawings represent ornaments. In the caves of Lescaux in France, more than 1,000 pictures, dating from the early Stone Age, and all in good perspective, were discovered in 1940. In painted pictures, the lines have often been pre-drawn, mostly scratched in. The oil paints (many times sprayed onto the surface) possess a remarkable luminosity.

These drawings, showing the mental awakening of man, are the most wonderful inheritance left to us by the people of the Ice Ages. Artistic achievements of later periods—even after the Middle Ages—in no way compare with these rock pictures.

From Northern Europe we know of pictures that have been chiseled on cliff walls. It is possible that they were once colored. In the Bay of Vingen, to the north of Bergen, one can see more than 800 single figures, mostly of stags, but also of articles which may well represent traps and devices for hunting.

Very beautiful wall drawings have been found in Egyptian burial chambers. During the Old Empire of that country, that is between 3,200 and 2,270 B.C., the drawings were mostly hewn into the walls or made in relief. During the Middle Empire (2,100 to 1,700 B.C.) and the New Empire (1,555 to 712 B.C.) drawings and paintings were made on plaster. The whole of man's life on Earth and in the next world is portrayed in these Egyptian wall drawings, along with

LAYOUT of a gold mine; Egyptian drawing on papyrus, dating from about 1300 B.C. *(In the Library at Turin.)*

innumerable technical implements. In those dating from the Old Empire, many human figures are shown writing or drawing; their utensils also have been excavated. In many cases it is quite clear that the figure of a man standing by some scales and counting cattle is meant to be a clerk; sometimes it almost certainly represents a draftsman.

The ground plan of a house, dating from about 2,000 B.C. was found in Mesopotamia; it had been scratched into brick at a scale of 1:360. Our illustration (above right) shows the drawing of an Egyptian gold mine dating from 1,300 B.C.; it is kept today in the library in Turin. The cloth has broken into a number of perpendicular strips. The drawing itself is black, the lettering red. Three mountains are shown in the top part, and four in the bottom part; the summits of the lower ones are pointing downwards. The map represents the gold district near Bechen east of Koptos. At the base of the mountains are two valleys. It is indicated that the lower valley is covered by either rock or shrub. Another valley running at an angle conects the two. The mines are within these mountains. Large buildings have been sketched into the right hand upper mountain. In the center, closely hatched in black, is a large pond in the middle of which stands a large stone memorial with a rounded top, a reminder of the establishment of the water source. In the valley opposite the pond, four houses have been drawn.

Other forms of portrayals are known to us from ancient times. When the city of Syracuse was occupied by the Romans in 212 B.C., a warrior enountered the 75-year-old mathematician and engineer, Archimedes, sitting before a drawing he had made on a slate strewn with sand. We assume that the enemy knew of his part in the determined defence of the town. As he was being led away by the warrior, he said, "Take my head, but do not touch what I have drawn!" This gave birth to one of the first quotations of world literature, namely, "Do not disturb my circles!" Had the sand been mixed with a binding material, it would have set, and the drawing might have been preserved.

It was a step forward when, instead of sand poured over a slate, wax was used and the drawing made in the hardened layer with the help of a stylus made of horn or metal. Here we already have the first kind of *reissbrett* (engraving board). The word reminds us of the very old type of engraving. The draftsman was once called *reisser* (engraver) for he did not merely draw, but engraved the pictures in wood, and so made the first printing blocks, namely, woodcuts.

(To be continued)

Shortage of Engineers? Try Technicians

Graduates of two-year technical institute programs work efficiently in various engineering capacities

by Robert H. Creamer

MANY PEOPLE in industry do not understand what a technician is, how he is trained, and what he can do. An accurate evaluation of the technician's function, however, reveals that he fills the void that has existed between the skilled craftsman and the professional engineer. His training is approximately half as long in duration as that of the engineer. However, in many instances he is doing work that was formerly performed by the engineer; in so doing, he is making a sizable contribution to the design effort.

Today many technicians are receiving their education at technical institutes. A typical program in Mechanical Design Technology is given below. It should be noted that technical institute programs are highly specialized, and are terminal in nature. The graduate of an engineering school will achieve a higher level in the mathematics course, and he will diversify by taking related technical courses in other fields, plus some cultural courses.

In a curriculum such as Mechanical Design, the technical institute student receives intensive training in the machine and tool design fields. Without the use of higher mathematics, he is able to select materials for components, analyze the forces acting on these members, and calculate the dimensions of parts, such as cams, gears, springs, shafts, bearings, brakes, clutches and flywheels. Since he is also skilled as a draftsman, he can put together necessary detail and assembly working drawings.

Where can technicians be utilized in industry? They can be used in practically every department where engineers may be found. In addition to design and development work, the engineering technician will frequently find employment in departments such as sales, service, production engineering, safety engineering, plant layout and industrial engineering.

In the past, many industries have selected their technicians from men who have attended engineering schools for one or two years, but who did not complete the program for some reason. While such individuals may have a good background in mathematics and basic sciences, they will not have had enough technical courses to step into industry without additional on-the-job training. On the other hand, the student who has completed a technical institute (terminal) type of program is qualified to become a good technician.

The engineering technician bridges the gap that exists between the professional engineering and the skilled craftsman. Properly trained, he combines the theoretical design ability of the professional engineer and the manufacturing "know-how" of the artisan. He is an important link in producing modern devices that contribute to our rapidly expanding economy.

Mechanical Design Technology Program*

1ST YEAR

Technical Mathematics	Technical Mathematics
Physics	Introduction to Machine Design
Applied Drafting	Physics
Graphic Statics	Mechanics
Materials & Processes	Elements of Mechanism
Basic Chemistry	

2ND YEAR

Industrial Orientation	Tool & Die Design Drafting
Electrical Applications	Structural Design
Strength of Materials	Materials Testing
Applied Machine Design	Plant Layout & Automation
Machine Design	
Kinematics	
Technical Writing	
Tool & Die Design Theory	

*Offered at Temple University Technical Institute. (Four Semesters)

STUDENTS receive instruction in Mechanical Drafting and Design Course.

The Author

ROBERT H. CREAMER is Director of Mechanical Design Technology, Temple University Technical Institute, Philadelphia, Penna.

Spring Drafting Principles

Part V

Flat Springs and Miscellaneous Springs, Spring Finishes, and Glossary of Spring Terms

By Albert L. Godshall and Gerald L. Kilmer

INTERESTING and commonly used types of springs are covered under the miscellaneous heading. These include (1) flat springs (cantilevers, beam, and leaf), (2) bent forms, (3) snap rings, and (4) spring washers; see Figue V-1. These springs store and deliver energy by bending.

All dimensions should be given on a drawing for these springs. When drawing wire forms use true dimensions, dimension from center to center, and specify generous but realistic tolerances.

Spring Tolerances

THERE ARE NO arbitrary tolerances which apply to springs. Therefore, machine-type tolerances should not be used on spring drawings. Instead, draftsmen should refer to the spring manufacturer's data for realistic tolerances.

It is also advisable not to use "title block" tolerances. Block tolerances, as found on preprinted drawing sheets, generally relate to solid shapes, and rarely are intended to apply to coiled wire. Whenever possible, encourage your engineering department to use tolerance tables, nomographs, or charts which apply specifically to springs. Supporting material is usually available from the spring manufacturer.

To more intelligently specify spring tolerances, draftsmen should know that variations in the physical characteristics of a spring (such as length, coil diameter, and initial tension) depend upon variations in spring materials, the capabilities of machinery, and the degree of control exerted over the manufacturing process. While machine variations can be reasonably well controlled by close in-process inspection, material variations are far less correctable.

Drafting Equipment

GOOD SPRING drafting requires the proper drafting equipment. The following equipment is highly recommended for all spring drafting:

1. A drop-center bow compass.
2. A celluloid template with a series of precision dimensioned holes for drawing curves and circles.
3. A drafting machine or an adjustable triangle.

Spring Finishes

DRAFTSMEN should use good judgment in specifying finishes. The

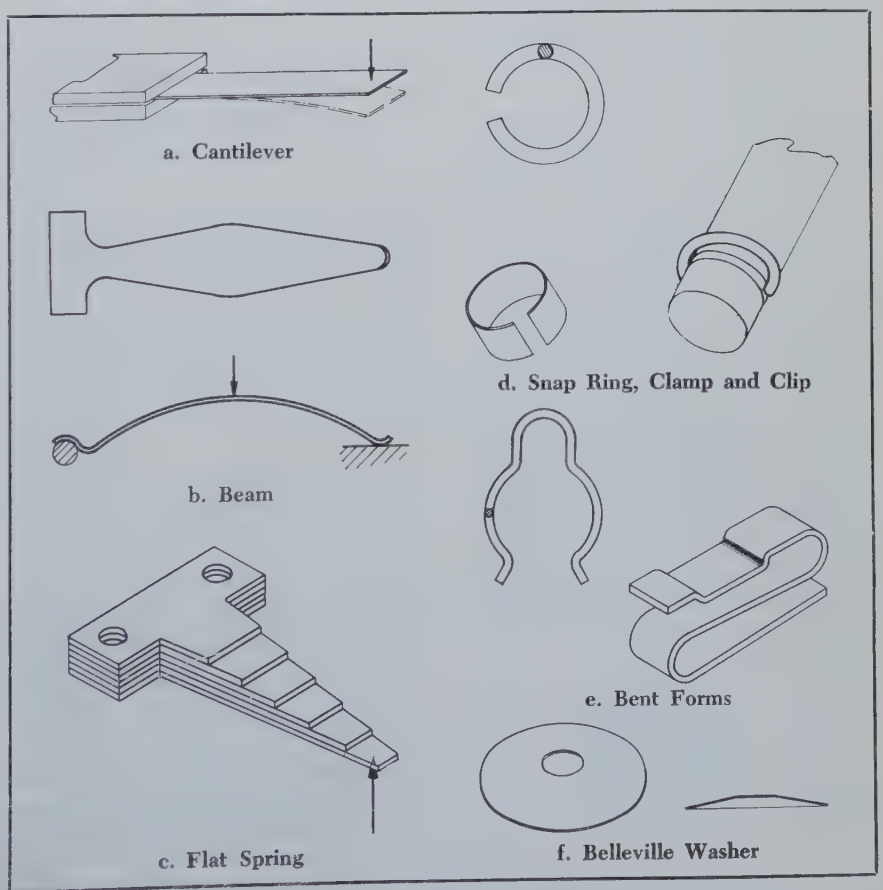

FIGURE V-1. Flat Springs and Miscellaneous Springs.

GLOSSARY OF SPRING TERMS

ACTIVE COILS are those coils which are free to deflect when a load is applied to the spring. In most extension springs, all the coils are active. There is a definite difference between active coils and total coils in compression springs.

ANGULAR RELATIONSHIP OF HOOKS applies to extension springs, and refers to the relative position of the hooks to each other. Since the angular relationship varies in the manufacture of springs, it is recommended that a tolerance be placed on this specification, unless the hooks may vary at random.

BLUE—See "Stress Relief."

BODY LENGTH refers to the over-all length of the active coils in an extension spring. Does not apply to compression springs.

CLOSED ENDS—See "Squared Ends, Not Ground."

CLOSED LENGTH (HEIGHT)—See "Solid Height."

COILING is the forming of wire into a spring on an automatic coiling machine.

DRAW—See "Temper."

ELASTICITY refers to the ability of a material to return to its original form after having been extended, compressed, bent, or twisted.

ELASTIC LIMIT is the maximum stress to which a material may be safely subjected. Higher stresses would produce permanent set.

ENDURANCE LIMIT is the maximum stress at which any given material will operate indefinitely without failure. This stress varies with the working stress range.

FATIGUE is a type of failure which results in breakage when springs are operated repeatedly at a stress in excess of the endurance limit. This may occur at a stress below the elastic limit of the material.

FINAL LOAD in a compression spring refers to the load at the shortest length the spring must operate. In an extension spring, it refers to the load at the longest length at which the spring is required to operate. (As opposed to "initial load.")

FINAL TORQUE in a torsion spring is the torque at the largest deflection angle of the arms at which the spring must operate.

FREE ANGLE is the angle between the arms of a torsion spring when the spring is not loaded.

FREE LENGTH is the length of a spring without load. This length is the overall length of a compression spring or the length measured inside the hooks at the ends of extension springs.

FREQUENCY (IMPRESSED) is the rate of external load application in cycles per second.

FREQUENCY (NATURAL) is the inherent rate of free vibration of a spring itself in cycles per second.

GRADIENT is the load required to deflect a spring a given distance. Gradient is usually specified in pounds per inch. This factor is also known as "rate," "scale," "load factor" and "spring constant."

HARDENING of spring materials is usually accomplished by heat treating. The word usually implies that the material is heated to a temperature above the critical point and quenched in oil or water.

INDEX is the ratio of mean diameter to wire diameter (D/d).

INITIAL LOAD in a compression spring refers to the load at the longest length the spring must operate. In an extension spring, it refers to the load at the shortest length the spring is required to operate. (As opposed to "final load.")

INITIAL TENSION in an extension spring refers to the "pre-load" which has been wound into the coils of a spring during the coiling operation and which must be overcome before the coils will start to open.

INITIAL TORQUE in a torsion spring is the torque at the smallest deflection angle of the arms at which the spring must operate.

MANUFACTURING VARIATION is the inherent process variation experienced in manufacturing. This is independent of a specified tolerance.

MODULUS OF MATERIAL is a measurable coefficient which expresses the stiffness of a material. The modulus of most materials does not vary appreciably with the hardness or temper.

MODULUS IN SHEAR (G) is the measurable coefficient of the stiffness of a material deformed by twisting.

MODULUS IN TENSION (E) is the measurable coefficient of the stiffness of a material deformed by extending, compressing, or bending.

MOMENT is a twisting action which tends to produce rotation. It is usually expressed in lbs.-ft. or in lbs.-inches.

OPENING OF HOOKS is the space between the end of the wire and the body of a spring. It is sometimes necessary for assembly purposes.

OPERATING DEFLECTION refers to the motion of the spring between operating lengths in the application.

PERMANENT SET takes place when a material is deflected so far that its elastic properties have been exceeded. When this is the case, a spring does not return to its original dimension upon release of the load.

PITCH is the distance from center to center of adjacent coils in a spring. This specification applies to the spring in its free position, and is sometimes known as "lead" or is inversely specified as "coils per inch."

PLAIN ENDS is a description of the end finish of a compression spring when there is constant pitch for all its coils. This type of end is sometimes called "open ends" and can be either ground or not ground.

PRESS—See "Remove Set."

PRIMARY LOAD is the term used to describe the important load requirement for a spring. (Can be initial or final load depending upon the application.)

REMOVE SET is an operation applied to compression springs. This operation apparently increases the elastic limit of the material by inducing favorable residual stresses. The springs are coiled longer than desired so that the length will be correct after the set is removed. Each spring must be compressed solid, coil to coil, in order to remove the set. The operation is sometimes known as "pressing," "setting," or "cold setting."

RESIDUAL STRESS is induced in a material when it is deformed or permanently set.

SCALE—See "Gradient."

SECONDARY LOAD is a term which refers to the less important of two load requirements in a spring. (Can be initial or final load depending upon the application.)

SET—See "Remove Set."

SOLID HEIGHT is the length of a compression spring when a sufficient load has been applied to bring all coils in contact with the adjacent coils and additional load causes no further deflection. This is sometimes known as "solid length" or "closed height."

SQUARED AND GROUND ENDS is a term used to specify ends of a compression spring where the pitch of the last coil is reduced to square off the end as much as possible after which the ends are ground to produce a flat seat. This is also known as "squared ends ground" or "closed ends ground."

SQUARED ENDS, NOT GROUND is a term used to specify ends of compression springs where the pitch of the last coil is reduced to square off the end as much as possible without grinding. This is also known as "squared ends," "closed ends," and "closed ends not ground."

STRESS is the intensity of force per unit area which produces an internal force equal to and opposite in direction to the external load on the spring. When a spring at rest supports a load, this internal force resists further deflection under the load. Stress is expressed in pounds per square inch.

STRESS RANGE is the difference in operating stresses at maximum and minimum load.

STRESS RELIEF is a low temperature heat treatment performed after coiling to remove undesirable residual stresses induced in the wire during the coiling operation. Compression and extension springs should be stress relieved to avoid an apparent reduction in the elastic limit due to these coiling strains. On the other hand, torsion springs and some spring rings should not be stress relieved, because the residual coiling stresses tend to increase the apparent elastic limit for these springs. This operation is sometimes called "bluing," and, incorrectly, "drawing" or "tempering."

TEMPER is the heat treating of hardened steel below the critical temperature to reduce hardness and, therefore, brittleness and to thus improve its spring properties.

TOLERANCE is a permissible variation for a given specification. In establishing the tolerance for a specification, the manufacturing variation should be considered. Greater accuracy than indicated by the manufacturing variation can only be obtained by additional manufacturing or inspection operations adding to the cost of the springs.

TORQUE—See "Moment."

TOTAL COILS is the number of coils in the spring, as the name implies. The term is used for compression springs only, and need not be used if the active coils are specified.

WINDING is the forming of wire into a helix by wrapping it around an arbor.

WIRE GAUGE is a specification for the size of the wire to be used but is only identifiable when the table is also given. The proper procedure is for the designer to select the desired size from the appropriate wire gauge table for the material and then to specify only the decimal size indicated.

FIGURE V-2. Glossary of Spring Terms.

most common spring finish is cadmium plating. This finish provides excellent corrosion resistance, flexes with the coils and thus does not chip or peel and looks good. Zinc plating is an adequate substitute.

"Black Japanning" or enameling used to be a favorite finish but is now less common, as more modern finishes cover better, do not become brittle or chip. Depending upon quantities involved, black Japanning can be more costly than cadmium plating.

Chromium plating is expensive and is not recommended as a spring finish although it is sometimes specified for its decorative value. Nickel plating is sometimes used on copper alloys but it is not recommended since it tends to be brittle and chips easily.

In many circumstances, a plain finish is perfectly satisfactory. When no other finish is specified, the spring supplier normally supplies "plain-finish" springs which have been dipped in rust inhibiting oil for protection during shipment and in short time storage.

For corrosion resistance, the following finishes are normally applied (listed in order of ability to resist corrosion):

1. Cadmium plating with a chromate treatment such as "Iridite" (colored chromate finishes are sometimes used for color coding);
2. Cadmium or zinc plating;
3. Paint or enamel;
4. Rust inhibiting oil.

In cost, finishes would compare as follows:

1. Rust inhibiting oil, lowest cost;
2. Black Japanning or enameling, next to lowest, except for small quantities when this finish can be more expensive than cadmium plating.
3. Zinc or cadmium plating or cadmium plating plus chromate treatment.

No finish should be necessary on the following materials: stainless steel, nickel alloys, and copper alloys.

The Authors

ALBERT L. GODSHALL and GERALD L. KILMER are Chief Draftsman and Spring Design Engineer, respectively, at Hunter Spring Company, Division of American Machine & Metals, Inc., Lansdale, Pa.

DRAFTING TRENDS

In a typical application of the POST Diazo Materials Selector Chart, a draftsman, supervisor and reproduction specialist solve a special print-making problem in short order.

Solve unusual reproduction problems with new Diazo Selector Chart

Keeping up with rapid developments in graphic reproduction and communication techniques is a difficult job these days, even for the experts.

From the engineer's and draftsman's point of view, it's largely a matter of sorting out the specific information which helps him do a better job.

The new POST Diazo Materials Selector Chart does just that—provides a condensed, tabular reference piece that helps you anticipate the ideal diazotype prints for various needs before they occur. This convenient chart gives brief information on sensitized papers, intermediates and specialties in terse "what, when, why and where" style.

If you're concerned, for instance, with print distribution to different departments, units or groups, then prints on a variety of colored stocks might be the answer.

Increasing print production from diazo equipment with a lower-power light source . . . making legible prints from worn old tracings . . . even making copies from an opaque print . . . all can be handled by use of new POST 206M-14, a fast, extra-sensitive whiteprint paper.

Suppose a design conference calls for a poster, actual size, made from a large engineering drawing, rigid enough for display, tough enough for extreme handling and on-the-spot sketches? POST diazo-sensitized cardstock in 32 or 50 lb. weight can turn the trick on standard reproduction equipment, ammonia process or semi-moist. For many more helpful solutions to similar situations, ask for your personal file-size copy, of the POST Selector Chart, available from your POST dealer or Frederick Post Company, 3656 North Avondale Avenue, Chicago 18, Illinois.

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Drafting Know-How

Industry speaks to schools and colleges about the youmg engineering graduate

by Earl D. Black

EDITOR'S NOTE: *The report which follows is the result of a project begun at General Motors Institute to determine the amount of drafting which an engineer should know. Specifically, the Institute wanted to develop courses in drafting which would meet the requirements of its trainees and still fit within a curriculum where the amount of time available for drafting training was reduced.*

Subsequently, and because of the importance of the subject to General Motors Institute and to those interested in drafting education everywhere, the study was amplified to include statements from personnel in other firms, and to present it to the Engineering Graphics Division of the American Society of Engineering Education.

Do our readers have comments to add?

IT IS GOOD to take inventory of the drafting needs of the young engineer in order that courses may be organized to meet his concurrent and future requirements. At least some assistance is needed during the first few years of his engineering practice while he is in transition from immediate post - collegiate to full - work status.

In this day of specialization, no one is likely to succeed as a lone wolf. Mr. Thomas E. Seavey, Master Mechanic of Pontiac Motor Division, General Motors Corporation, says:

> "The young engineer should have acquired the tools of communication—a command of the written and oral language as well as engineering drawing in order that he may communciate accurately with others."

Specialization on an undergraduate level in college is not practical. The graduate must learn to adjust to the needs of numerous specific and sometimes unrelated jobs. Even similar jobs in different plants often vary greatly in requirements because of personalities of those in supervisory capacity. Therefore the young engineer must not only have a thorough background in basic technical and scientific knowledge that is required with his job, but he must be able to get along with people to fully secure their cooperation.

The school must give the young engineer a start on his career. He must have some ability with which he can pay his way while he is going through job orientation. He must have some proficiency in this ability. He is not likely to stay on any one specific job long until he has acquired general engineering status and an interest in specialization not only of his own choosing but more to the satisfaction of his supervisor. It often takes years for the young engineer to settle down in a steady pull on the job.

LET US examine a few direct quotations from men of industry:

> "An engineer or scientist, no matter how talented, must depend upon a designer for his living unless he can express his own ideas on paper. A crude sketch or a poorly written report is not adequate in today's competitive market. Without a doubt, the highest paid men in the engineering profession on technical assignments are accomplished designers with an engineering education." — Robert P. Ernest, Section Supervisor, Reciprocating Engines Department, Engineering Research, Ford Motor Co

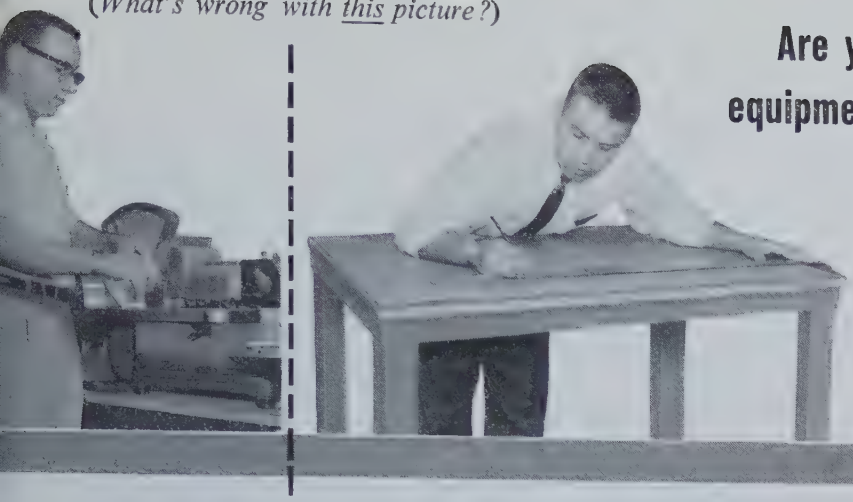
> "An engineer in industry must not only acquire proficiency in fundamentals of graphics but he has much use for descriptive geometry, drawing for processes, tool drawing, making of layouts, strength of materials, mechanics and thermodynamics." — Robert Potter, Senior Mechanical Engineer, Plant Engineering, Chevrolet V-8 Engine Plant, General Motors Corporation.

> "Great ideas or advances in science and engineering are subject to loss or retardation because the engineer or scientist lacks the ability to convey the information in a simple form like a drawing. The relatively few hours spent in making drawings offsets a tremendous number of hours that it takes to interpret cold technical descriptions. Accurate drawings also minimize misinterpretation." —John M. Hubbard Senior Engineer-in-Charge, Engineering Illustration and Parts Densification Department, Production Engineering Activity, Fisher Body Division-Detroit, General Motors Corporation.

> "Even the long-haired, scientific engineer must somehow get down to earth and converse with other mortals or he will lose out in the race with those ordinary individuals who create things for the benefit of mankind. It is not necessary or desirable that top

(*Continued on page* 30)

(What's wrong with this picture?)



Are your mailboys working with better equipment than your engineer-draftsmen?

Your mailroom equipment is expensive—but, because it does essential work, it pays off. However, you may be badly handicapping some of your most *skilled, professional talent*—your drafting men—if they're still working with antiquated, inadequate, uncomfortable equipment.

Your draftsmen, your productivity, deserve new Hamilton space-and-time-saving equipment—from Bruning

For its cost, Hamilton drafting equipment will produce more marked improvement in efficiencies than any other equipment expenditures in your plant.

It steps up productivity—directly and unmistakably—because: (a) construction and design features insure greater accuracy, consistent performance; and (b) anatomy-conscious design greatly reduces fatigue, permits the exact work positions and heights best suited for individual jobs.

Hamilton equipment *continues* to deliver this superior ease and performance, because it is so carefully constructed, of such quality components, that it outlasts ordinary equipment by many years. It *stays* modern, because it totally conforms to individual needs.

Shown here are three of the many products in the complete Hamilton line. Learn about the many other units Hamilton offers. Our expert planning personnel can be of considerable assistance, suggesting the arrangements best for you.

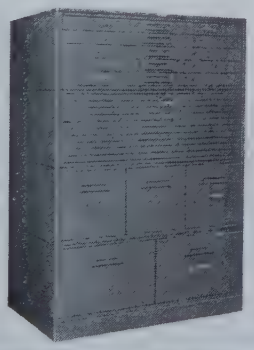
Hamilton De Luxe Auto-Shift Table

You'll get peak productivity and greater work quality from your board men when equipped with the new Auto-Shift. It is considerate of comfort, and delivers wide flexibility of adjustments.

Perfect, fully seasoned drawing surface; front-to-back filing in full-width drawers; stylized leveling legs . . . many more functional and styling features.

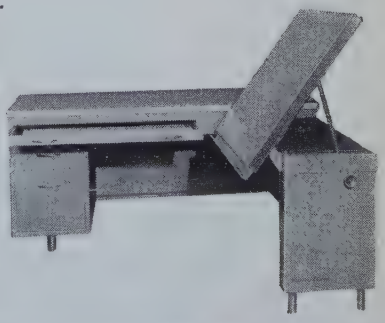
Hamilton Interlocking Plan Files

Provide greater protection, accessibility, and classification. Assembly shown includes (top to bottom) 5-drawer unit for semiactive material, 10-drawer section with tracing lifter that makes every sheet as accessible as a top sheet, and two vertical drawer units. Interlocking roll tracing unit also available. Interlocking caps and bases, with latter available for variety of stack heights. Rugged construction, smooth drawer action, trim beauty.



Hamilton L-Contour Table

While occupying very small space, this table provides man-sized, fully comfortable work area. Board fully adjustable from horizontal to vertical. Working surface exceptionally stable, perfectly balanced. Many other features—plus the quality of construction found only in Hamilton equipment.



Put draftsmen in a "position" to do better, faster work!

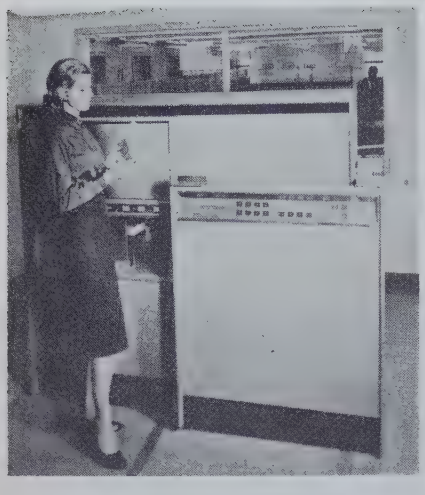
Bruning's all-new Neoglide drafters literally help draftsmen straighten up and do faster, better work.* They provide complete maneuverability on any board at any angle without adjustment! Reinforced U-beam construction assures rigidity, strength, and accuracy. Resistance-free movement of vertical beam and hidden counterweight provide fast "floating" action. Touch-control protractor head gives automatic, pinpoint angle selection.

*A study of 300 draftsmen showed 35% savings in drawing time—1/5 the backaches—on vertical or near vertical boards.

BRUNING

CHARLES BRUNING CO., INC.
1800 CENTRAL RD., MT. PROSPECT, ILLINOIS

New Products



Card-Punching Printer

Punched cards can now be computed, edited, punched, and printed on both sides in a single operation, using a system developed by Remington Rand, Division of Sperry Rand Corp., 315 Park Avenue South, New York 10, N. Y. The system is based on the new Univac On-Line Card-Punching printer, which is capable of printing a total of 1,820 characters of information on one punched card at speeds up to 1,560 lines a minute. The On-Line principle permits data to be fed directly at high speed from the central computer to the printing unit, eliminating intermediary steps. Use of the system is said to result in reducing file space, and in speeding up search time.

Proportioning Rule

Those engaged in graphic arts production work will find many uses for a measuring device that incorporates a simplified slide rule, plus 15 ruling, measuring and proportioning scales. Called Scalerule, the device is manufactured by Fairgate Rule Co., Inc., Cold Spring - On - The - Hudson, New York. It has three basic uses: it proportions in picas, inches and square inches; it measures in inches, picas, agate lines and in 6-, 8-, 10-, and 12-point; and it transposes between inches, agate lines and picas.

Lead Holder Set

Combination lead holder and pointer in a pocket-sized box is offered by Alvin & Co., Inc., 611 Palisado Ave., Windsor, Conn. This drawing tool set includes a five - inch mechanical lead holder, a Kleen-Point lead pointer, a tube of refill leads and an extra set of replacement blades. The lead holder is said to grip the lead firmly, without shearing or weakening it. A button at the top of the barrel ejects the lead; when released, it secures lead at any desired position. The pointer has a graphite cup to retain lead particles. Set is priced at $3.95.

Negative Paper

Continuous tone, contact speed paper for reproducing film negatives, called Tru-Grade, has been introduced by Peerless Photo Products, Inc., Shoreham, Long Island, N. Y. Intended primarily for "in-plant" photographic reproduction departments, the new paper is available in five different contrasts, ranging from #00, a soft-contrast emulsion to Grade #3, a high-contrast material. The paper has a fixed development rate, said to minimize the possibility of over-development when processing many prints at a time.

Portable Drafting Instrument

Drafting machine for the professional, mounted on a 23- by 31-inch drawing table that is complete with stand, is offered by David Miller & Associates, P.O. Box 572, Beverly Hills, Calif. Called the Draftette No. 12-ST, the aluminum drafting machine has a one-piece, 6 by 9-inch scale and 360° protractor. The board can be tilted to any angle, has pencil and paper ledge, and can be used with standard home or office chair. The outfit is said to be compact, sturdy, and easy to store. Price is moderate.

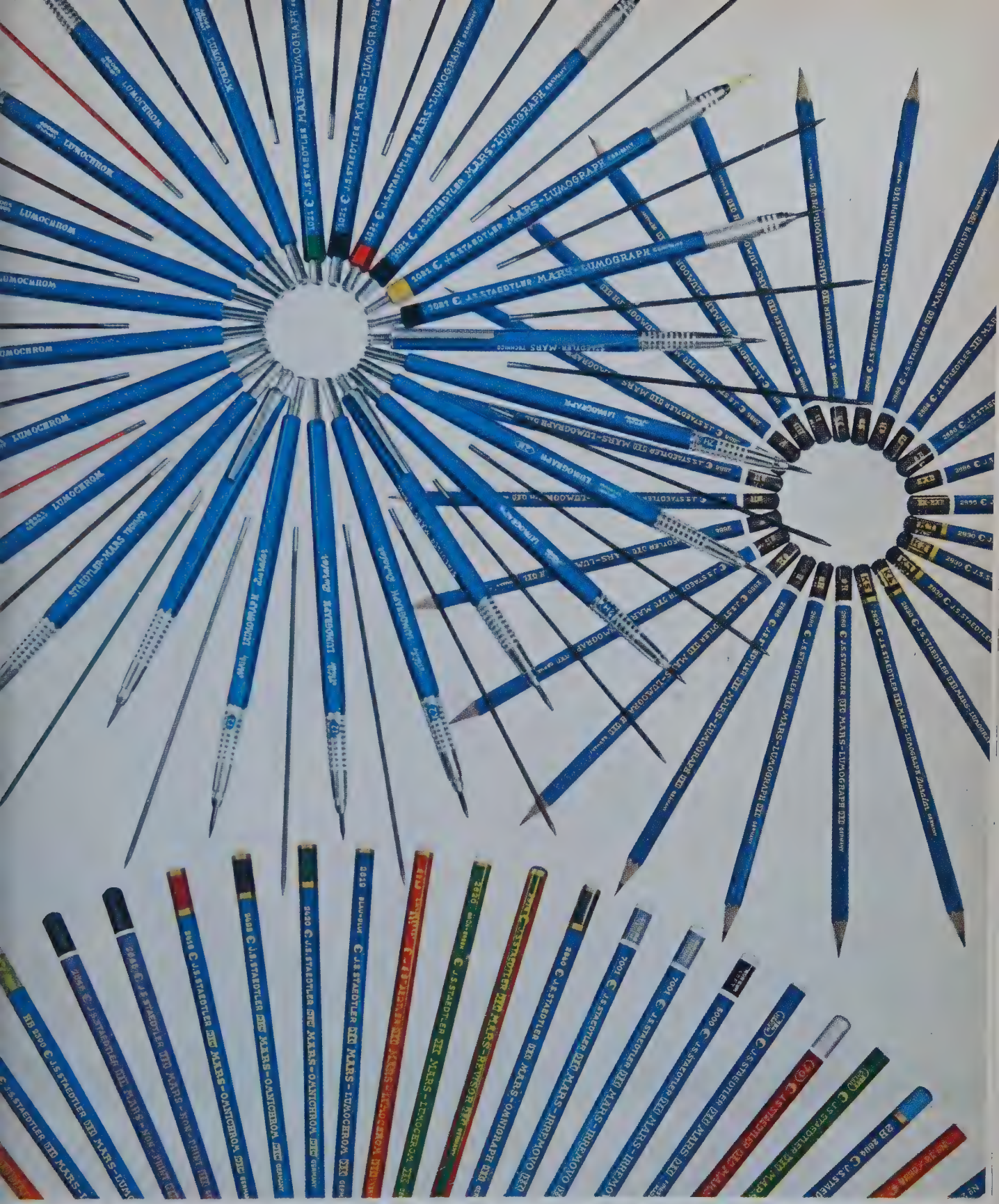
(For additional information regarding the new products described here, contact the manufacturer directly. Complete addresses are included.)

Paper Trimmer

Unique machine for cutting paper board and film, has a circular knif which rolls against a straightedge t create the shearing action. Both ele ments are hollow-ground and do no require sharpening, since repeated us causes each to sharpen the other. Th cutter carriage travels on a guid rail, sliding easily on three bearings Available in two sizes, 24-inches an 51-inches wide, the Metocut machin is distributed in the U. S. by Bienfan Products Corp., Metuchen, N. J. Th machine is said to give a precise, clea paper edge, and to require no main tenance other than occasional oilin of the carriage bearings.

Whiteprinting Machines

Dry diazo reproduction machine available with 24-inch, 42-inch, an 54-inch printing widths have bee announced by Paragon-Revolute Div sion, Charles Bruning Co., Inc Mount Prospect, Ill. These Paragon Revolute Star Models are equippe with 4,000, 5,000, or 7,500 wa lamps, and have a speed range from 45 to 75 fpm. All models fe ture automatic separation. Patente stainless steel perforated rollers insu full development at top speed. Th machines have front and rear pri delivery trays. Enclosed roll-sto compartments hold two 100-foot rol Air knife-suction separation picks t tracing and print off the cylind Like all Paragon-Revolute diazo m chines, the Revolute Star models a available on a Bruning leasing plan.



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Microfilm System Solves Engineering Record-keeping Problems

COMPLEX GROWTH and management problems prompted Ford, Bacon & Davis, a consulting engineering firm established in 1894, to turn to microfilm in late 1957 as a method for their engineering and business record-keeping system. This 66-year-old firm, specializing in design, construction, appraisals and industrial engineering, has principal offices in New York, Chicago, San Francisco, and Monroe, La. Its work has taken its engineers to thirty-two countries on the six continents, as well as to most of the United States.

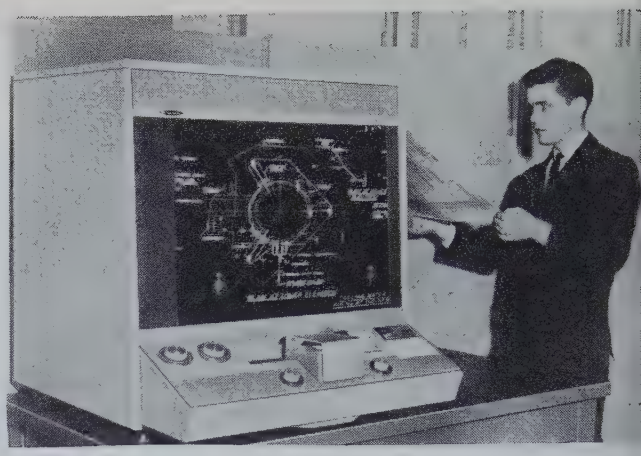
In 1957 more than 10,000 square feet of expensive floor space was occupied by a 63-year accumulation of records; auxiliary warehousing off the premises was proving costly; engineers and draftsmen were being slowed in their work because of the relative inaccessibility of necessary blueprints and files. Worst of all, the problem was continuing to grow.

Storage and space were not the only problems. Since the firm frequently was required to turn over original drawings to clients, these original drawings were blueprinted for the permanent record's file in New York. The blueprints tended to fade, and to lose their clarity with repeated use.

THE FILMING PROJECT

ALL ENGINEERING drawings and blueprints were filmed on 35mm and mounted in aperture cards. Although the company does not use sorters, selectors and the like, the aperture cards and a corresponding file of master cards were punched with proper identification as to job, drawing number, and title, at the time of film mounting. When final filming was completed, the engineering documents file had been transferred to 20,000 aperture cards, each properly punched so that at any time the company can introduce automatic machine filing. Both sets of cards (aperture and master) are maintained in *one filing cabinet*, replacing the vast space formerly needed for blueprints and specification filing both within the office and in the warehouse. As a safeguard against loss or damage to the aperture cards, a security roll of 35mm film is kept in the general files.

For the non-engineering filing comprising some 8,000,000 documents — correspondence, field reports, accounting records, suppliers bills, etc., a different approach was



IN TEN SECONDS, clerk can produce 18″ by 24″ copy o any one of 20,000 engineering drawings on 35mm microfilm

used. Here the sole objective was to put a volume o paper record on film and to relieve the physical files a much as possible. All files were therefore reviewed, and filmed on 16mm microfilm rolls; a card index was established for reference purposes. After microfilming, this type of record was destroyed with two exceptions—correspondence which is kept for five years, and the original or document copy of all reports made by the firm.

When the microfilm system was first introduced, two viewers were ordered: one for 16mm film for use in general files, and one for 35mm film for engineering use. These were quickly found to be impracticable.

According to Stuart R. Fleming, vice-president and manager of FB&D's engineering department, there is little value in having equipment which permits an engineer or draftsman merely to *look* at an enlargement of a drawing. What was needed was a means of taking the original drawing back to the drafting table or desk, where it would be on hand for reference. Reproduction from aperture cards by commercial methods was not only time-consuming (48 hours or more), but expensive.

After studying the problem, the company ordered a reader-printer*—a relatively inexpensive table model which shows an enlargement of a frame of microfilm and, at the press of a button, produces an enlarged paper reproduction. The paper print takes about 10 seconds. This is the system—a combination of engineering drawings on microfilm in aperture cards and a reader-printer for viewing and reproduction—which is now in use at FB&D's New York office.

"Today," says Mr. Fleming, "if one of our draftsmen wants a copy of a drawing he can have it in a matter of seconds. Previously it took as long as 72 hours. We now put the original on sharp, clear film before turning it over to the client, and it remains that way, no matter how many copies we have to pull. We find this a vast improvement over the old blueprint system."

From an economy standpoint, Mr. Fleming is equally enthusiastic. "The cost of a paper print from our reader-printer is anywhere from one-fifth to one-half that of a commercial print from an aperture card," he says. "Furthermore, the cost of installing the entire system, exclusive of our own labor charges, was less than our warehouse rental for two years."

*Filmac 200 Reader-Printer, manufactured by Minnesota Mining & Mfg. Co., St. Paul, Minn.

New Literature

Drawing Instruments Catalog (No. 0-DI), has been issued by V. & E. Mfg. Co., 766 South Fair Oaks Ave., Pasadena, Calif. This illustrated catalog contains information on their stainless steel and nickel-plated steel 4½-inch compasses, 6½-inch speed bow compasses, 4½-inch and 4-inch compasses and pen compasses, pen attachments, beam compasses and beam attachments, friction dividers, drop bow compasses, and a broad range of ruling pens.

Drafting Templates Catalog (No. 58), with full descriptions and illustrations of a variety of precise symbol templates, may be obtained from Timely Products Co., Box 416, Baltimore, Ohio. These exact, die-cut time-savers include house plan templates, furniture templates, window templates, and plumbing templates for architects), ASA electrical symbol templates, bolt and nut templates, flowplanner templates (for the petroleum and organic chemical industries), ellipse templates, circle templates, alphabet templates, and lettering templates. Prices are listed.

Printed Circuit Tapes and Shapes (Bulletin No. 163-D), presenting ready pre-cut, self-sticking materials for making circuit layouts on clear film or translucent tracing cloth, is available from W. H. Brady Co., 727 W. Glendale Ave., Milwaukee 9, Wis. Savings of drafting time, and precise reproducible copy are said to result from the use of these materials.

Drafting Facts Memorandum, a loose-leaf publication crammed with information as to how drafting equipment (machines and adjustable boards) relate to drafting efficiency in terms of time and cost, has been compiled by Franz Kuhlmann, K. G. manufacturers of drafting equipment, Wilhelmshaven, Germany. Facts and figures in the Memorandum are based on studies made by Batelle Institute. Typical drafting room layout diagrams are included, and Kuhlmann offers to supply space-saving suggestions for any drafting office, if supplied with scaled prints in triplicate. Copies of the Kuhlmann Memorandum may be requested from their U. S. representative, Unitech Corp., 10 Colfax Ave., Clifton, N. J.

(*Continued from page* 22)
flight engineers spend long hours on the drafting board actually making drawings. However, they must know as much or more about the theory of drawing."—J. R. Simonin, Engineering Design Dept., Detroit Edison Co.

"Every engineer should have the command and proficiency in the geometry of engineering drawing and be able to read all types of drawings—product drawings, tool drawings, plant layouts, etc."—S. E. Ford, Superintendent of Labor Standards, Fisher Body —Plant No. 1—Flint, General Motors Corporation.

"Our chemical engineers in research usually spend from two to three days per month on a drawing board in an attempt to explain ideas of development. We cannot well use a chemical engineer who cannot take advantage of the preciseness that the graphical language gives in communication." — J. J. Reis, Manager, Process Engineering, Springdale, Pa., Research and Development Center, Pittsburgh Plate Glass Company.

"Drafting is probably the engineer's most important form of communication. Engineers working with graphics mold intangible ideas and theories into tangible goods and products. The real creative engineering is done in the drafting room. There must be a design before there can be a test or experimental program.

"As with any language, skill can be maintained only by practice, and certainly a few months of minimum drafting training received in college cannot be considered adequate practice for mastering such a vital skill.

"The most valuable men in an engineering development group are those whose broad background in designing permits them to follow a project from the initial freehand sketch to the finished prototype. Drafting is by no means losing its place as an engineering tool." — Charles A. Chayne, Vice President, Engineering Staff, General Motors Corporation.

Technical institutes and college programs in the technical areas are springing up all over the country in an effort to fill the need for engineering performance. The Technical Institute Division of the American Society for Engineering Education is also the fastest growing division of ASEE. Technical advancement depends upon the scientist, engineer, and technician working cooperatively together. Scientific discoveries are made because the engineer and technician are able to take the scientific discoveries and apply them to machines, vehicles, processes, and procedures.

Science and engineering are interdependent. A man trained only in economics, for example, is not likely to be able to design a successful automobile, a highway, or a water-treatment plant. Likewise, a man trained only in the technical aspect of these commodities will not stay in business long when his understanding of economics is short, inasmuch as economy is a major controlling factor in public acceptance of a product. Industry in general is more interested in graduates who are well qualified in fundamentals rather than descriptive courses.

Industry has joined hands with colleges and universities in support and recognition of engineering education by way of scholarship programs and out-and-out gifts. It is the business of the colleges and universities to accept the challenge. It is the task of industry to continue its support and keep the educational directors completely informed as to what is needed by the young engineering graduate.

Changing times require changing concepts and improvement in methods. To assure increasing and effective performance, we must find the best marriage of knowledge and ability to perform, in order to secure maximum contribution.

The Author

EARL D. BLACK is Head of Engineering Drawing, General Motors Institute, Flint 2, Mich. *In addition to his affiliation with General Motors he is Chairman of the Committee on Industrial Relations of the Engineering Graphics Division of the American Society for Engineering Education.*

Advertising Index

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